A simulation study on HF/VHF sounder observation of Martian/Venusian surface/subsurface through the ionosphere

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A computer simulation has been carried out to study the dispersion effect of planetary ionospheric plasma on the delay of a radio sounding pulse.

Nonmagnetized terrestrial body with ionosphere was modeled. The ionosphere is assumed to be in a quiet state and to have laminar structure. The planetary surface is

assumed to be a plane. The nadir echo has been exclusively studied in the simulation.

The apparatus is an FMCW radar which sweeps the frequency of transmission pulse for 2 MHz in 200 micro-sec. Cases of five center frequencies have been investigated, i.e., 5,

10, 20, 50, and 100 MHz. The sounder instrument is at the altitude of 100km above the surface.

Simulation results show decrease of nadir surface reflection echo intensity as a function of TEC at a fixed frequency of transmission pulse, and increase of the echo

intensity as a function of transmission pulse frequency at a fixed TEC. Applying the result to a sounding observation of Martian surface through the Martian ionosphere

whose TEC is typically 1*10^15 [1/m^2], the echo strength is estimated as a function of transmission pulse frequency as follows:

5MHz : -23 dB
10MHz : -17 dB
20MHz : -11 dB
50MHz : -3 dB
100MHz : 0 dB.

The results imply that Martian sounding observation would have a serious problem for subsurface sounding in HF band.